OVERALL ENVELOPE TDV ENERGY APPROACH (Page 1 of 6) ENV-3C

Project Name:	Date:	Climate Zone:

WINDOW RATIO CALCULATION §143(b)

A. TOTAL LINEAR DISPLAY PERIMETER		FT × 6 FT =	ft²	DISPLAY AREA
B. TOTAL GROSS EXTERIOR WALL AREA		ft² × 0.40 =	ft²	40% of GROSS EXTERIOR WALL AREA
C. ENTER LARGER OF (A or B)			ft²	MAXIMUM STANDARD AREA
D. ENTER PROPOSED WINDOW AREA			ft²	PROPOSED AREA

If the Proposed Window Area is greater than the Maximum Standard Area, then go to Window Adjustment step below.

E. WINDOW WALL RATIO = (Row D) Divided by (Row B) = _____ Must meet RSHG in Table 143-A, 143-B, or 143-C

WEST WINDOW RATIO CALCULATION

F. WEST LINEAR DISPLAY PERIMETER		FT × 6 FT =	ft²	WEST DISPLAY AREA
G. WEST EXTERIOR WALL AREA		ft² × 0.40 =	ft²	40% of WEST EXTERIOR WALL AREA
H. ENTER LARGER OF (F or G)			ft²	MAXIMUM STANDARD WEST AREA
I. ENTER PROPOSED WEST WINDOW AREA			ft²	PROPOSED WEST WINDOW AREA

If the Proposed West Window Area is greater than the Maximum Standard West Area, then Go to Window Adjustment step below.

J. WINDOW WALL RATIO = (Row I) Divided by (Row G) = _____ Must meet RSHG in Table 143-A, 143-B, or 143-C

Combined Area for North, East and South Walls

K. N/E/S DISPLAY PERIMETER (A Minus F)		FT × 6 FT =	ft²	N/E/S of WEST EXTERIOR WALL AREA
L. N/E/S EXTERIOR WALL AREA (B Minus G)		ft² × 0.40 =	ft²	40% N/E/S AREA
M. ENTER LARGER OF K or L			ft²	MAXIMUMN STANDARD N/E/S/ AREA
N. PROPOSED N/E/S/ WINDOW AREA (D Minus I)			ft²	PROPOSED N/E/S/ AREA

Window Adjustment

O. IF D>C and/or if I>H, Proceed to the calculation Step 1 for all walls or Step 2 for West wall. If not, go to the Skylight Area Test on ENV-3C Page 6, **CALCULATE ADJUSTED AREAS.**

1. IF D>C: Use the calculated Window Adjustment Factor (WAF) for all walls.

MAX. STANDARD AREA (from C)		PROPOSED WINDOW AREA (from D)		WINDOW ADJUSTMENT FACTOR
	÷		=	

2. IF I>H: Calculate one Window Adjustment Factor (WAF) for the West wall.

MAX. STANDARD WEST AREA (from H)		PROPOSED WEST AREA (from I)		WEST WINDOW ADJUSTMENT FACTOR
	÷		=	

MAX. STANDARD AREA (from C)		PROPOSED AREA (from D)		WEST WINDOW ADJUSTMENT FACTOR
	÷		=	

Project Name:	Date:	Climate Zone:

SKYLIGHT RATIO CALCULATION §143(b)

	ACTUAL GROSS ROOF AREA		MAXIMUM ALLOWED STANDARD SKYLIGHT AREA	
A IF Atrium/Skylight Height is ≤ 55 ft; **or**		ft2 × 0.05 =	ft^2	
B. IF Atrium/Skylight Height is > 55 ft		ft^2 × 0.10 =	ft^2	
C. Proposed Skylight Area		ft^2		
D. Skylight Ratio = Proposed Skylight Area (Row C) Divided by Actual Gross Roof Area =			%	SRR_{Prop}
E. Maximum Allowed Skylight Roof Ratio = Maximum Allowed Standard Skylight Area (Row A or B) Divided by Total Gross Exterior Roof Area =			%	SRR_{STD}

IF THE PROPOSED SKYLIGHT AREA IS GREATER THAN THE STANDARD SKYLIGHT AREA PROCEED TO THE NEXT CALCULATION FOR THE SKYLIGHT AREA ADJUSTMENT. IF NOT GO TO PAGE 3 OF 6.

SKYLIGHT AREA ADJUSTMENT

IF F>D, Proceed To Calculation Step 1

Step 1. Calculated the Skylight Adjustment Factor (SAF).

STANDARD SKYLIGHT AREA		PROPOSED SKYLIGHT AREA (IF E = 0 ENTER 1)		SKYLIGHT ADJUSTMENT FACTOR (SAF)
	÷		=	

CARRY THE WINDOW ADJUSTMENT FACTOR (SAF) TO PAGE 6 OF 6 TO CALCULATE THE ADJUSTED AREA

OVERALL ENVELOPE TDV ENERGY APPROACH

 ENV-3C

Project Name:	Date:	Climate Zone:

TDV for the Standard Design Building, See Reference Nonresidential Appendix NA5.2

Occupancy Type and Coefficients Tables ☐ Nonresidential, See Table NA5-3 ☐ 24-Hour Use, See Table NA5-4 ☐ Retail, See Table NA5-5

A	B	C	D	E	F	G	H	I	J	K	L	M
						Criteria			Coefficients for U-factor[7]	Coefficients for SHGC[7]	Coefficients for VT[7]	
Assembly Type[1]	Orientation	Number Of Like Assembly Type[4]	Roofs or Floor Mass Type[5]	Exterior Surface Area	Fenetration Type	U-factor[6]	SHGC[7]	VT[8]	$Cs_{u,i}$	$Cs_{s,i}$	$Cs_{t,i}$	Standard TDV Energy[8]
											Sum of Total Standard Design	

1. Indicate type of assembly for the Envelope (e.g. Wall, Floor, Roof, Window, Skylight & Door). One assembly type for each row.

2. Enter the area of each different assembly.

3. Enter the type of fenestration; M=Manufactured, SB=Site-built, SK= Skylight and F=Fabricated.

4. Grouping of like assemblies in the same orientation is allowed. Iindicate the number in column E.

5. Enter Roofs, Floors, Walls,and for Mass Walls the catergoies are light mass(HC<7), medium mass (7<=HC,15), and heavy mass (HC>=15).

6. Standard Design U-factor are from Table 143-A, B or C.

7. Standard Design SHGC are from Table 143-A, B or C. Enter "0" if not applicable. Note: Not all vertical windows have an overhang then assume SHGC as value entered.

8. To calculate the fenestration standard design VT in Column H. Multiply Column G by 1.2.

*9. Coefficients for; U-factor (**$Cs_{u,i}$**), SHGC (**$Cs_{s,i}$**), and VT(**$Cs_{t,I,}$** can be found in Table NA5.2, through Table NA5.5 of the Reference Nonresidential Appendices NA5. The Coefficient for SHGC and VT are only enter for the **fenestration products**. Enter "0" when not applicable.*

10. *Calculate the TDV Standard Design for for each Envelope Aassembly Type: TDV_{Std} = Column C x [Column E x (($U\text{-factor}_{Si} \times C_{Sui}$) + ($SHGC_{Si} \times C_{Ssi}$) + ($VT_{Si} \times C_{Sti}$))] for each Assembly Type. See Nonresidential Manual Examples in Section 3.7.1 for details.*

OVERALL ENVELOPE TDV ENERGY APPROACH

 ENV-3C

Project Name:	Date:	Climate Zone:

TDV for the Proposed Design Building, See Reference Nonresidential Apendix NA5.3

Occupancy Type and Coefficients Tables ☐ Nonresidential, See Table NA5-3 ☐ 24-Hour Use, See Table NA5-4 ☐ Retail, See Table NA5-5

A	B	C	D	E	F	G	H	I	J	K	L	M	N
					Criteria			Coefficients for					Proposed TDV Energy[11]
Assembly Type[1]	Orientation[2]	Number Of Like Assembly Type[2A]	Total Exterior Surface Area[3]	Fenestration Type[4]	U-factor[5]	SHGC[6]	VT[7]	U- factor[8] $C_{su,i}$	SHGC[8] $C_{Ss,i}$	VT[8] $C_{t,i}$	Cool Roof[9] M_{CR}	Overhang[10] M_{OH}	
										Total Proposed Design[12]			
												Proposed ≤ Standard	

1. Indicate type of assembly for the Envelope (e.g. Wall, Floor, Roof, Window, Skylight & Door). One assembly type for each row.

2. Indicate the orientation for walls, doors & windows. 2A. Note: Grouping of like assemblies in the same orientation is allowed. Enter the number in column C.

3. Indicate the Exterior Surface Area of the Assembly for that one assembly or if like assemblies then the total surface area of all assemblies in the same orientation.

4.Enter the type of fenestration; M=Manufactured, SB=Site-built, SK= Skylight and F=Fabricated.

5.Standard Design U-factor are from Table 143-A, B or C for the appropriate assembly type.

6. Standard Design SHGC are from Table 143-A, B or C. Enter "0" if not applicable. Note: Not all vertical windows have an overhang then assume SHGC as value entered.

7. To calculate the fenestration standard design VT in Column H. Multiply Column G by 1.2.

*8. Coefficients for; U-factor ($Cs_{u,i}$), SHGC ($Cs_{s,i}$), and VT($Cs_{t,I}$, can be found in Table NA5.2, through Table NA5.5 of the Reference Nonresidential Appendices NA5. The Coefficient for SHGC and VT are only entered for the **fenestration products**. Enter "0" when not applicable.*

9. Calculate the Cool Roof, M_{CR}, first by using the next page (Page 5 of 6). Enter the value in the Proposed Column L.

10. Calculate the Overhang M_{OH} on the next page (Page 5 of 6). Enter the value in the Proposed Column M.

11. The Proposed TDV energy use for all assemblies other than roofs must be equal to or less than Standard TDV in Page 3 of 6. Therfore; TDV_P = Column D x [(U factor x CSu) + (CRui x URi x MCRi) + (SHGCP x CSsi x MOH) + (VTP x CSt)] Enter the calculated value in Column N.

12. Sum up all the Proposed TDV Energy in Column N and enter value in the cell. Similarly enter the sum of all Standard TDV Energy and compare. Proposed must be ≤ to the Standard.

OVERALL ENVELOPE TDV ENERGY APPROACH (Page 5 of 6) ENV-3C

Cool Roof Multiplier (M_{CR})

PROJECT NAME	DATE

Occupancy Type and Coefficients Tables	☐ Nonresidential, See Table NA5-3	☐ 24-Hour Use, See Table NA5-4	☐ Retail, See Table NA5-5	Climate Zone:

Coefficients of						Calculation	
A	B	C	D	E	F	G	
Reflectance	Emittance	Proposed Aged Solar Reflectance	Standard Aged Solar Reflectance[1]	Proposed Thermal Emittance	Standard Thermal Emittance	Cool Roof Multiplier[2]	
C_{Ref}	C_{Emit}	$\rho_{aged\ prop}$	$\rho_{aged\ std}$	ε_{prop}	ε_{std}	$M_{CR,I}$	
							Enter multiplier in Page 4 of 6 Column L.

Excerpt from Table NA5-2. Where: Standard design values for Solar Reflectance and Thermal Emittance.	Standard Aged Solar Reflectance (Column D)	Standard Thermal Emittance (Column F)
Low-Rise, Low-Sloped, CZ2 through CZ15	0.55	0.75
Low-Rise, Low-Sloped, CZ1 and CZ16	0.10	0.75
High-Rise, Low-Sloped, CZ10 through CZ15	0.55	0.75
High-Rise, Low-Sloped, CZ1-9 and CZ16	0.10	0.75
Steep-Sloped, CZ2 through CZ15	0.25	0.75
Steep-Sloped, all other	0.10	0.75

1. *Proposed Aged Design Solar Reflectance;* $\rho_{aged\ prop} = (0.7\ x\ \rho_{init\ prop}) + 0.06$, Where ($\rho_{init\ prop}$) *reflectance value is found in the CRRC Directory. Enter results of the Cool Roof Multiplier equation in footnote 2.*

2. Cool Roof Multiplier $M_{cR,I} = 1 + C_{Ref}\ x\ (\rho_{aged\ prop} - \rho_{aged\ std}) + C_{Emit}\ x\ (\varepsilon_{prop} - \varepsilon_{std})$ **or** 1+ Col A *x* (Col C - Col D) + Col B *x* (Col E – Col F)

Overhang Multiplier (M_{OH})

Occupancy Type and Coefficients Tables	☐ Nonresidential, See Table NA5-3	☐ 24-Hour Use, See Table NA5-4	☐ Retail, See Table NA5-5	Climate Zone:

	Coefficients of		Fenestration Overhang			Calculation	
A	B	C	D	E	F	G	
Overhang Orientation	1st Projection Factor[1]	2nd Projection Factor[1]	Horizontal Projection (ft^2)	Vertical Distance (ft^2)	Projection Factor[2]	Overhang Multiplier[3]	
	a_i	b_i	H	V	PF	$M_{OH,I}$	
							Enter multiplier in Page 4 of 6 Column M.

1. Where: a_i *and* b_i *are the coefficients for the overhang projection factor (see tables) and is climate zone dependent.*

2. PF= H/V *(Horizontal (H) projection of the overhang from the surface of the window in feet, but no greater than V and the Vertical (V) distance from the window sill to the bottom of the overhang, in feet.) Enter results in Column F.*

3. $M_{OH,I} = 1 + (a_i\ x\ PF_i) + b_i\ x\ PF_i^2$. *Enter results in Column G.*

OVERALL ENVELOPE TDV ENERGY APPROACH (Page 6 of 6) ENV-3C

PROJECT NAME	DATE

WINDOW AREA ADJUSTMENT CALCULATIONS

A		B	C	D	E	F	G
					WINDOW ADJUSTMENT	ADJUSTED WINDOW	ADJUSTED WALL
WALL NAME (e.g. Wall-1, Wall-2)	ORIENTATION N E S W	GROSS AREA	DOOR AREA	WINDOW AREA	FACTOR (From Page 1of 6)	AREA (D×E)	AREA B-(F+C)
	☐ ☐ ☐ ☐						
	☐ ☐ ☐ ☐						
	☐ ☐ ☐ ☐						
	☐ ☐ ☐ ☐						
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TOTALS:							

SKYLIGHT AREA ADJUSTMENT CALCULATIONS

A	B	C	D	E	F
ROOF NAME (e.g. Roof-1, Roof-2)	GROSS AREA	SKYLIGHT AREA	SKYLIGHT ADJUSTMENT FACTOR (From Page 2 of 6)	ADJUSTED SKYLIGHT AREA (C×D)	ADJUSTED ROOF AREA (B - E)
TOTALS:					